

10-02-00

A

**UTILITY PATENT APPLICATION TRANSMITTAL**

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 015685.P069First Named Inventor or Application Identifier Uhlik et al.Express Mail Label No. EL580087293US

ADDRESS TO: Assistant Commissioner for Patents
 Box Patent Application
 Washington, D. C. 20231

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. Specification (Total Pages 45)
(preferred arrangement set forth below)
 - Descriptive Title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claims
 - Abstract of the Disclosure
3. Drawings(s) (35 USC 113) (Total Sheets 6)
4. Oath or Declaration/Power of Attorney (Total Pages 5)
 - a. Newly Executed (Original or Copy)
 - b. Copy from a Prior Application (37 CFR 1.63(d))
(for Continuation/Divisional with Box 17 completed) (**Note Box 5 below**)
 - i. **DELETIONS OF INVENTOR(S)** Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
 - a. Computer Readable Copy
 - b. Paper Copy (identical to computer copy)
 - c. Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. Assignment Papers (cover sheet & documents(s))
9. 37 CFR 3.73(b) Statement (where there is an assignee)
10. English Translation Document (if applicable)
11. a. Information Disclosure Statement (IDS)/PTO-1449
 b. Copies of IDS Citations
12. Preliminary Amendment
13. Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. a. Small Entity Statement(s)
 b. Statement filed in prior application, Status still proper and desired
15. Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. Other: _____

17. If a **CONTINUING APPLICATION**, check appropriate box and supply the requisite information:

Continuation Divisional Continuation-in-part (CIP)
of prior application No: _____

18. Correspondence Address

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Correspondence Address Below

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September 29, 2000
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Spiri Worley
Name of Person Mailing Correspondence

Signature

Date

FEE TRANSMITTAL FOR FY 2000**TOTAL AMOUNT OF PAYMENT (\$)** \$1906.00**Complete if Known:**

Application No. _____
 Filing Date Concurrently Herewith
 First Named Inventor Uhlik et al.
 Group Art Unit Not yet assigned
 Examiner Name Not yet assigned
 Attorney Docket No. 015685.P069

METHOD OF PAYMENT (check one)

1. The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

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2. Payment Enclosed:
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FEE CALCULATION**1. BASIC FILING FEE**

<u>Large Entity</u>	<u>Small Entity</u>	<u>Fee Description</u>	<u>Fee Paid</u>
Fee	Fee	Fee	Fee
Code	(\$)	Code	(\$)
101	690	201	345
106	310	206	155
107	480	207	240
108	690	208	345
114	150	214	75
		Utility application filing fee	<u>690.00</u>
		Design application filing fee	_____
		Plant filing fee	_____
		Reissue filing fee	_____
		Provisional application filing fee	_____
SUBTOTAL (1) \$ 690.00			

2. EXTRA CLAIM FEES

		<u>Extra Claims</u>	<u>Fee from below</u>	<u>Fee Paid</u>
Total Claims	68	- 20** = 48	X 18.00	= 864.00
Independent Claims	7	- 3** = 4	X 78.00	= 312.00
Multiple Dependent				= _____

**Or number previously paid, if greater; For Reissues, see below.

Large Entity Small Entity

<u>Large Entity</u>	<u>Small Entity</u>	<u>Fee Description</u>
Fee	Fee	Fee
Code	(\$)	Code
103	18	203 9
102	78	202 39
104	260	204 130
109	78	209 39
110	18	210 9
		Claims in excess of 20
		Independent claims in excess of 3
		Multiple dependent claim, if not paid
		**Reissue independent claims over original patent
		**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) \$ 1176.00

FEE CALCULATION (continued)

01/10/2000

- 1 -

PTO/SB/17 (6/99)

Patent fees are subject to annual revisions. Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid.

See Forms PTO/SB/09-12

3. ADDITIONAL FEES

<u>Large Entity</u>	<u>Small Entity</u>	<u>Fee Description</u>	<u>Fee Paid</u>
Fee Code	Fee (\$)	Fee Code (\$)	
105	130	205	65
127	50	227	25
			Surcharge - late filing fee or oath
			Surcharge - late provisional filing fee or cover sheet
139	130	139	130
147	2,520	147	2,520
112	920*	112	920*
			Non-English specification
			For filing a request for reexamination
			Requesting publication of SIR prior to Examiner action
113	1,840*	113	1,840*
			Requesting publication of SIR after Examiner action
115	110	215	55
116	380	216	190
117	870	217	435
118	1,360	218	680
128	1,850	228	925
			Extension for response within first month
			Extension for response within second month
			Extension for response within third month
			Extension for response within fourth month
			Extension for response within fifth month
119	300	219	150
120	300	220	150
121	260	221	130
138	1,510	138	1,510
140	110	240	55
			Petition to institute a public use proceeding
			Petition to revive unavoidably abandoned application
141	1,210	241	605
			Petition to revive unintentionally abandoned application
142	1,210	242	605
143	430	243	215
144	580	244	290
122	130	122	130
			Petitions to the Commissioner
123	50	123	50
126	240	126	240
581	40	581	40
			Petitions related to provisional applications
			Submission of Information Disclosure Stmt
			Recording each patent assignment per property (times number of properties)
146	690	246	345
149	690	249	345
			For filing a submission after final rejection (see 37 CFR 1.129(a))
			For each additional invention to be examined (see 37 CFR 1.129(a))

Other fee (specify) _____

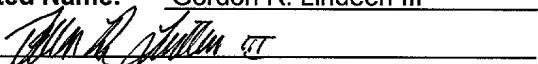
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SUBMITTED BY:

Typed or Printed Name: Gordon R. Lindeen III

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Date 9/29/00

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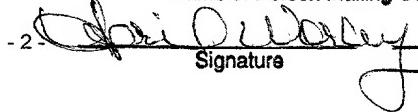
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-2-  PTO/SB/17 (06/00)
 Signature  Date 9/29/00

Attorney Docket No.: 15685.P069

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TITLE OF THE INVENTION

RADIO COMMUNICATIONS SYSTEM WITH A MINIMAL BROADCAST CHANNEL

INVENTORS

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RADIO COMMUNICATIONS SYSTEM WITH A MINIMAL BROADCAST CHANNEL

BACKGROUND OF THE INVENTION

Field of the Invention

5

The present invention applies to radio communications systems in which several remote terminals communicate voice or data with a base station and, in particular, to such systems in which the base stations use a broadcast channel with a very low data rate.

10 Description of the Prior Art

Mobile radio communications systems such as cellular voice radio systems typically have a base station available for use by mobile remote terminals, such as cellular telephones or wireless web devices. The base station typically transmits a broadcast channel (BCH). The BCH is broadcast to all remote terminals whether they are registered on the network or not and informs the remote terminals about the network. In order to access the network, a remote terminal must normally tune to and listen to the BCH before accessing the network. A remote terminal will typically scan a range of likely frequencies when it wants to access the network until it finds the strongest BCH, it will then use the information in the BCH to access the network.

20

The BCH is typically filled with data about the network in order to reduce the amount of information that must be transmitted to any particular remote terminal in the accessing, registering, authenticating or logging-on process. As a result, after registration, the remote terminal does not require any further information other than a specific channel assignment from the already known channel set in order to initiate a call.

The broadcast channel is typically transmitted at a relatively high power level so that any remote terminal in any location within the range of the base station can receive it clearly. The high power level and the high data rate in combination make it likely that the broadcast channel will interfere with other traffic channels of the radio

5 communications system. When there are several different base stations transmitting on one or more broadcast channels, the possibility of and amount of interference is greater.

The present invention reduces the interference caused by the broadcast channel. This allows less of the channel resources to be dedicated to the broadcast channel and more of the channel resources to be dedicated to the traffic channels. In one

10 embodiment, the broadcast channel is transmitted to all remote terminals that enter within the range of the base station while other communications are transmitted directly to the intended remote terminal on a channel that creates much less interference with other remote terminals. In such an embodiment, the present invention, by transmitting less data on the broadcast channel and more data on a specifically directed channel, reduces

15 broadcast channel interference still more.

BRIEF SUMMARY OF THE INVENTION

In one embodiment, the present invention comprises transmitting a broadcast burst in a broadcast channel from a base station of a radio communications system. The 5 invention further comprises receiving a request burst from a user terminal, and transmitting a message burst from the base station to the user terminal from which the request was received. The message burst includes a description of the channels available on the radio communications system for receiving messages from user terminals.

In another embodiment the present invention comprises receiving a plurality of 10 timing sequences on a broadcast channel from at least one base station, determining network timing using the received timing sequences, determining a network access request transmission time using the network timing, transmitting a network access request at the determined time, and receiving a message burst from a base station. The message burst includes a description of the channels available on the wireless network.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings in which like reference numerals
5 refer to similar elements and in which:

Figure 1 is a diagram illustrating an exemplary architecture of a wireless communication system according to one embodiment of the present invention;

Figure 2 is a diagram illustrating transmission patterns of a multi-channel spatial diversity transmitter according to one embodiment of the present invention;

10 Figure 3 is a block diagram illustrating a spatial diversity multiple access processor according to one embodiment of the present invention;

Figure 4 shows a simplified block diagram of a base station on which an embodiment of the invention can be implemented;

15 Figure 5 is a diagram illustrating an example of a broadcast burst structure according to one embodiment of the present invention;

Figure 6 is a diagram illustrating an example of a Configuration Request burst structure according to one embodiment of the present invention;

Figure 7 is a diagram illustrating an example of a Configuration Message burst structure according to one embodiment of the present invention; and

20 Figure 8 is a diagram illustrating a communications sequence according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Basic Structure

5 Figure 1 shows an example of a wireless communications system or network in which a number of subscriber stations, also referred to as remote terminals or user terminals, (symbolically shown as handsets) 20, 22, 24, are being served by a base station 100 that may be connected to a wide area network (WAN) 56 for providing any required data services and connections external to the immediate wireless system. The present

10 invention relates to wireless communication systems and may be a fixed-access or mobile-access wireless network using spatial division multiple access (SDMA) technology in combination with multiple access systems, such as time division multiple access (TDMA), frequency division multiple access (FDMA) and code division multiple access (CDMA). Multiple access can be combined with frequency division duplexing

15 (FDD) or time division duplexing (TDD). A switching network 58 interfaces with a WAN 56 for providing multi-channel duplex operation with the WAN by switching incoming WAN data to lines 60 of the base station 100 and switching outgoing signals from the base station 100, on lines 54 to the WAN. Incoming lines 60 are applied to signal modulators 62 that produce modulated signals 64 for each subscriber station to

20 which the base station is transmitting. A set of spatial multiplexing weights for each subscriber station are applied 74 to the respective modulated signals in spatial multiplexers 66 to produce spatially multiplexed signals 68 to be transmitted by a bank of multi-channel transmitters 70 using a transmit antenna array 18. The SDMA processor (SDMAP) 48 produces and maintains spatial signatures for each subscriber station for

25 each conventional channel, calculates spatial multiplexing and demultiplexing weights

for use by spatial multiplexers 66, and spatial demultiplexers 46, and uses the received signal measurements 44 to select a channel for a new connection. In this manner, the signals from the current active subscriber stations, some of which may be active on the same conventional channel, are separated and interference and noise suppressed. When

5 communicating from the base station to the subscriber stations, an optimized multi-lobe antenna radiation pattern tailored to the current active subscriber station connections and interference situation is created. An example of a transmit antenna pattern that may be created is shown in Figure 2. Suitable technologies for achieving such a spatially directed beam are described, for example, in U.S. Patents Nos. 5,828,658, issued Oct. 27,

10 1998 to Ottersten et al. and 5,642,353, issued June 24, 1997 to Roy, III et al.

Returning to Figure 1 spatial demultiplexers 46 combine received signal measurements 44 from the multi-channel receivers 42 and associated antenna array 19 according to spatial demultiplexing weights 76, a separate set of demultiplexing weights being applied for each subscriber station communicating with the base station. The

15 outputs of the spatial demultiplexers 46 are spatially separated signals 50 for each subscriber station communicating with the base station. In an alternate embodiment, the demultiplexing and demodulation processing are performed together in a nonlinear multidimensional signal processing unit. The demodulated received signals 54 are then available to the switching network 58 and the WAN 56. The multi-channel receivers also

20 receive timing signals from GPS (Global Positioning System) satellites or some other radio precision timing signal which is then provided to the SDMAP for precise timing that is synchronized across all base stations in the system.

In an FDMA system implementation, each multi-channel receiver and each multi-channel transmitter is capable of handling multiple frequency channels. In other

25 embodiments, the multi-channel receivers 42 and multi-channel transmitters 70 may

instead handle multiple time slots, as in a TDMA system, multiple codes, as in a CDMA system, or some combination of these well-known multiple access techniques.

Figure 3 shows a breakdown of a Spatial Division Multiple Access signal Processor (SDMAP) 48. The function of the SDMAP includes determining how many signals are present in a particular channel, estimating signal parameters such as the spatial location of the transmitters (i.e., directions-of-arrival (DOAs) and distance from the base station), and determining the appropriate spatial demultiplexing and multiplexing schemes. The inputs 44 to the SDMAP include outputs of base station receivers, one for each receiving antenna. In one embodiment, the receivers perform quadrature detection of the signals as in current systems, in which case there are in-phase (I) and quadrature (Q) components (signals) output from each channel behind each antenna. In another embodiment, a single down-converted component, I or Q or any combination thereof, is used. In one embodiment, the receivers digitize the data before passing it to the SDMAP. In another embodiment, digitization is performed in the data compressor 160.

In one embodiment of the invention, the SDMAP accomplishes its task by first obtaining estimates of important signal related parameters such as their directions-of-arrival (DOAs) without exploiting temporal properties of the signal. This is appropriate, for example, in situations where analog modulation schemes are employed and little is known about the signal waveform. In a second embodiment, known training sequences placed in digital data streams for the purpose of channel equalization can be used in conjunction with sensor array information to calculate signal parameter estimates such as DOAs and signal power levels. This information is then used to calculate appropriate weights 76 for a spatial demultiplexer, implemented in this embodiment as a linear combiner, i.e., a weight-and-sum operation. In a third embodiment, time-of-arrival (TOA)-related parameters from the parameter estimator are used in conjunction with

signal correlation parameters to ascertain which signals are multi-path versions of a common signal. Relative delays are then calculated such that the signals can be coherently combined, thus further increasing the quality of the estimated signals.

However, in another embodiment of this invention, the function of the spatial demultiplexer is performed in conjunction with the estimation of other source parameters such as the DOAs. As an example of one such embodiment of this type, the constant modulus property (i.e., constant amplitude) of various communication signals such as digital phase-shift-keyed (PSK) and analog FM waveforms can be exploited along with properties of the array of receiving antennas to simultaneously estimate the source waveforms as well as their DOAs using multi-channel constant-modulus algorithms (CMA) which are well-known in the art.

In another embodiment, extended Kalman filters, also well-known in the art, can be used to exploit these and similar properties. In these and similar embodiments, the function of the spatial demultiplexer 46 is assumed by the SDMAP 48, and the outputs 76 of the SDMAP are the spatially demultiplexed signals to be sent to the demodulators.

Referring again to Figure 3, data compression 160 is performed to reduce the amount of data, and, in one embodiment, consists of accumulation of a sample covariance matrix involving sums of outer products of the sampled receiver outputs in a particular channel. Hereafter, these sampled outputs are referred to as data vectors, and there is one such data vector at each sample time for each of the channels assigned to a particular base station. In another embodiment, the compressed data are simply the unprocessed data vectors. If I and Q signals 44 are output from the receivers, each data vector is a collection of m_r complex numbers, one for each of the m_r receiver/antenna pairs.

In a third embodiment, data compression also includes using known signal information such as training sequences present in wireless digital systems and mobile unit

transponder responses in current analog systems to calculate time-of-arrival (TOA) of a distinct periodic signal feature, a parameter containing valuable information related to the distance between cell sites and the wireless transmitter which is exploited in this embodiment.

5 Compressed data 162 are passed to a signal detector 164 for detection of the number of signals present in the channel. In one embodiment, statistical detection schemes are employed in conjunction with information from a SDMA controller 72 to estimate the number of sources present in the channel. This information and the (compressed) data 168 are sent to a parameter estimator 170 where estimates of signal
10 parameters including those related to the source locations (e.g., DOAs and range) are obtained.

Location-related parameter estimates 172 are passed to a source tracker 174. In one embodiment, the function of the source tracker is to keep track of the positions of each of the transmitters as a function of time. This is implemented by known nonlinear
15 filtering techniques such as the aforementioned extended Kalman filter (EKF). In another embodiment, velocities and accelerations of each of the wireless units in a particular channel are tracked as well. Inputs to the EKF in one embodiment include the DOAs and TOAs from the local base station. In another embodiment, DOA and TOA measurements from other nearby cell sites also receiving transmissions from the mobile units are
20 incorporated along with known locations of the cell sites to further improve the estimation accuracy of the EKF as is well-known in the art. The tracker 174 outputs are sent along with the (compressed) data 176 to a spatial demultiplexer controller 178, to control the function of the spatial demultiplexer, and to a spatial multiplexer controller 180 to control the function of the spatial multiplexer.

Figure 4 shows an alternative embodiment of a wireless communications system suitable for implementing the present invention. This system is typically coupled to a switching network and WAN similarly to the system of Figure 1 such as switching network 58 and WAN 56. In Figure 4, a plurality of antennas 103 is used, for example 5 four antennas, although other numbers of antennas may be selected. The outputs of the antennas are connected to a duplexer switch 107, which in this TDD system is a time switch. Two possible implementations of switch 107 are as a frequency duplexer in a frequency division duplex (FDD) system, and as a time switch in a time division duplex (TDD) system. When receiving, the antenna outputs are connected via switch 107 to a 10 receiver 205, and are mixed down in analog by RF receiver ("RX") modules 205 from the carrier frequency (for example around 1.9 GHz) to an FM intermediate frequency ("IF") of, for example, 384 kHz. This signal then is digitized (sampled) by analog to digital converters ("ADCs") 209 at, for example, 1.536 MHz. Only the real part of the signal is sampled. Thus, in complex phasor notation, the digital signal can be visualized as 15 containing the complex valued IF signal at 384 kHz together with an image at -384 kHz. Final down-converting to baseband is carried out digitally by multiplying the 1.536 megasamples per second real-only signal by a 384 kHz complex phasor. The result is a complex valued signal that contains the complex valued baseband signal plus an image at, for example, $-2 \times 384 = -768$ kHz. This unwanted negative frequency image is filtered 20 digitally to produce the complex valued baseband signal sampled at 1.536 MHz.

GrayChip Inc. GC2011 digital filters can be used to implement the down-converting and the digital filtering, the latter using finite impulse response (FIR) filtering techniques.

This is shown as block 213. The particular frequencies suggested above are provided by way of example. The invention can be adapted to suit a wide variety of RF and IF carrier 25 frequencies and bands.

There are, in the present example, four down-converted outputs from each antenna's GC2011 digital filter device 213, one per receive timeslot. The particular number of timeslots can be varied to suit network needs. While the present example uses four uplink and four downlink timeslots for each TDD frame, desirable results have also

5 been achieved with three timeslots for the uplink and downlink in each frame. For each of the four receive timeslots, the four down-converted outputs from the four antennas are fed to a digital signal processor (DSP) device 217 (hereinafter "timeslot processor") for further processing, including calibration, according to one aspect of this invention. Four Motorola DSP56303 DSPs can be used as timeslot processors, one per receive timeslot.

10 The timeslot processors 217 perform several functions including the following: received signal power monitoring; frequency offset estimation and time alignment; smart antenna processing including determining weights for each antenna element to determine a signal from a particular remote user; and demodulation of the determined signal.

The output of the timeslot processor 217 is demodulated burst data for each of the
15 four receive timeslots. This data is sent to a host DSP processor 231 whose main function is to control all elements of the system and interface with the higher level processing, which is the processing which deals with what signals are required for communications in all the different control and service communication channels defined in the system's communication protocol. The host DSP 231 can be a Motorola
20 DSP56303. In addition, timeslot processors send the determined receive weights to the host DSP 231. The main functions of the host DSP 231 specifically include:

- maintaining state and timing information;
- receiving uplink burst data from the timeslot processors 217;
- programming the timeslot processors 217;

- 00064000000000000000000000000000
- processing the uplink signals, including de-encrypting, de-scrambling, error
correcting code checking, and burst deconstruction of the uplink;
- formatting the uplink signal to be sent for higher level processing in other parts of
the base station;
- 5 formatting service data and traffic data for further higher processing in the base
station;
- receiving downlink messages and traffic data from the other parts of the base
station;
- processing of downlink bursts (burst construction, encoding, scrambling and
10 encryption);
- formatting and sending downlink bursts to a transmit controller/modulator, shown
as 237;
- programming the transmit controller/modulator 237, including determining and
sending transmit weight vectors to the transmit controller/modulator 237;
- 15 controlling the RF controller shown as 233; and
- maintaining and reporting modem status information, and controlling
synchronization.
- The RF controller 233 interfaces with the RF system, shown as block 245 and
also produces a number of timing signals that are used by both the RF system and the
20 modem. The specific tasks performed by the RF controller 233 include:
- producing timing signals for the RF system (RX and TX) and other parts of the
modem;
- reading transmit power monitoring values;
- writing transmit power control values;
- 25 producing the duplexer 107 switch box control signal; and

reading automatic gain control (AGC) values.

the RF controller 233 receives timing parameters and other settings for each burst from the host DSP 231.

The transmit controller/modulator 237, receives transmit data from the host DSP

5 231, four symbols at a time. The transmit controller uses this data to produce analog IF outputs which are sent to the RF transmitter (TX) modules 245. The specific operations transmit controller/modulator 237 performs are:

converting data bits into a complex modulated signal;

up-converting to an IF frequency using, for example, a GrayChip 2011;

10 4-times over-sampling the IF signal;

multiplying this 4-times over-sampled complex signal by transmit weights obtained from host DSP 231; and

converting the real part of the resulting complex valued waveforms via digital to analog converters ("DACs") which are part of transmit controller/modulator 237 to

15 analog transmit waveforms which are sent to the transmit modules 245.

The transmit modules 245 up-convert the signals to the transmission frequency and amplify the signals. The amplified transmission signal outputs are sent to antennas 103 via the duplexer/time switch 107.

20 Broadcast Channel (BCH)

The system of the present invention is initiated for each user terminal or remote terminal from the broadcast channel BCH which is transmitted as a burst from the base station to all potential user terminals. The BCH burst, unlike the traffic channel bursts, is 25 transmitted in all directions where user terminals may be, typically omnidirectionally but

the specific beam pattern will depend on the network. Accordingly, the BCH burst will create more interference on the system than spatially directed or lower power traffic channels TCH. For this reason, the data and modulation properties of the BCH channel are selected to minimize interference. An example of a broadcast burst structure is

5 shown in Figure 5. Some of the important BCH burst properties are as follows. The

BCH is computationally easy to find by scanning in real time having no knowledge of time-slot boundaries. It communicates enough basic information to enable a subsequent exchange of configuration request CR and configuration message CM between the base station and the user terminal. The BCH also provides good frequency offset and timing

10 update information to all user terminals, even when the BCH is not specifically directed toward any one user terminal in particular.

Table 1, below summarizes the content of an example of a BCH burst, as shown in Figure 5.

Duration	Contents
10 μ sec	ramp - up
272 μ sec	frequency correction training symbols f_1, f_2, \dots, f_{136}
256 μ sec	timing correction training symbols t_1, t_2, \dots, t_{128}
16 μ sec	broadcast preamble r_1, r_2, \dots, r_8
512 μ sec	information symbols $h'_1, h'_2, \dots, h'_{256}$
10 μ sec	ramp - down
14 μ sec	inter-burst guard time

15

Table 1

The frequency and timing correction training symbols can be set according to any one of many approaches well-known in the art. They can also be combined, exchanged with a synchronization sequence or eliminated.

The broadcast information symbols are constructed from a 15-bit broadcast message which is modulated and coded into a 256 bit sequence. The number of symbols as well as the structure and sequence of transmitted bits can be varied to suit a wide variety of applications. The presently described embodiment has been selected in order to minimize the amount of information transmitted in the BCH as well as to minimize the bit rate. The broadcast channel information symbols provide the information needed for a user terminal to request a configuration message from the base station. They also provide information to guide user terminal handover decisions.

Each broadcast message is mapped into a broadcast burst with the information shown below in Table 2.

Broadcast Message	
Field	# of Bits
BStxPwr	5
BSCC	7
BSload	3
Total	15

15

Table 2

BStxPwr is the effective isotropic radiated power of the broadcast message. This number indicates the power transmitted by the base station taking into account the number of amplifiers and diversity antennas available at the base station. For a 10 antenna broadcast channel, base station power = $(2 \cdot \text{BStxPwr} + 10)$ dBm.

BSCC is the base station color code, used by the user terminal to select training data for uplink bursts and to distinguish broadcasts of different base stations. In one embodiment, there are up to 128 different possible color codes. The color codes can be used to indicate a base station in a different location or a different modulator/demodulator 5 set in the same location.

BSload is the load on the base station, used by the user terminal to determine how frequently to send random access messages. BSload is an indication of the amount of unused capacity the base station has. It can be different from the number of active registered subscribers because subscribers can require different amounts of traffic 10 capacity. BSload represents the transmit and receive bit rates of each modem of the base station over a period of a few minutes measured against maximum possible loading.

In one embodiment, the BCH channel is shared by all base stations in the wireless communication system. Using the 7 bit BSCC, up to 128 base stations can be accommodated. The BCH is a time division duplex channel with a repeating frame. The 15 channel is a single RF carrier frequency used for uplink and downlink. For high noise environments or for increased robustness, the BCH can hop frequencies according to a predetermined scheme or be repeated on several different frequencies. The repeating frame includes the downlink BCH for each base station, labeled BS1 etc. as shown in Table 3 below. The next frame includes the uplink Configuration Request CR, labeled 20 CR1 etc. and downlink Configuration Message CM, labeled CM1 etc. Each frame also includes a number of reserved slots, shown as empty boxes below. These slots can be used for data traffic, if the broadcast channel is also used for traffic, for other control messages or reserved to reduce interference on other channels in the network. The frames are repeated for each respective base station 1 to 128 to build a superframe as

discussed in more detail below. After the last CM, CM128, the superframe repeats and begins again with the next superframe and the BCH for base station 1.

		Uplink			Downlink		
Superframe	Frame 1				BS1		
1	Frame 2	CR1			CM1		
	Frame 3				BS2		
	Frame 4	CR2			CM2		
		
	Frame 255				BS128		
	Frame 256	CR128			CM128		
	Frame 1				BS1		
2	Frame 2	CR1			CM1		
		

Table 3

A base station can be considered a collection of base station modems serving a group of contiguous RF carriers. Alternatively, a base station can be an installation with a set of modems at a single site. For other system configurations each modem modulator/demodulator set 52, 62 can be considered a base station. Each base station is assigned a unique 32-bit base station identifier, BSID. The BSID is used to derive a base station color code as follows: BS_{CC} = BSID mod 128. As a function of the BS_{CC}, a base station frequency hops, broadcasts BCH, listens for uplink CR, and sends downlink CM. Within a geographical region where radio transmissions overlap, the BSID should be assigned so that the BS_{CC} is uniquely assigned. No base station should be able to routinely see user terminals that are communicating with a base station of the same color code. Likewise, no user terminal should be able to see two base stations that are assigned

the same BS^{CC}. The total number of base stations as well as the number of frames in a superframe, the number of slots in a frame and the particular slots used for transmitting BCH bursts, CRs and CMs can be modified to suit particular applications.

To minimize, the data rate of BCH bursts still further, the BS^{CC} and BSload can
5 be removed from the BCH burst. The BCH burst then contains only training or synchronization and BStxPwr, the only information directly related to handover decisions. The user terminal can still distinguish and compare different base stations for selection and handover decisions based on timing of the received BCH bursts. The user terminal can also direct its CR message to a specific base station as shown in Table 3
10 based on timing. For a single base station system, the BStxPwr bits can also be deleted. If there is only one base station, it is not necessary to evaluate path loss but only whether the signal can be received. The rest of the network information can be learned upon registration, described below. Alternatively, since the BCH includes the BS^{CC}, the user terminal can be programmed to read the BS^{CC} and assume that BCH bursts with a
15 common BS^{CC} are from the same base station. In this way, the user terminal can learn a shortened frame repetition interval, and reduce the time needed to register with the system.

Registration

20 A user terminal forms a relationship with a base station called a registration. This registration begins by listening to the broadcast channel and ends with a handover, timeout, or disconnection. The first step of registration is accomplished by a remote by sending the Configuration Request burst CR and receiving a Configuration Message burst
25 CM. The CM contains basic configuration parameters such as hopping sequence

calculation parameters. Using the information from the CM, the user terminal then opens an unauthenticated stream using a random access registration request RA-rreq. This unauthenticated stream carries only in-band signaling data used to complete registration and assignment of a registration identifier RID and paging identifier PID. Using the RID 5 assigned at the end of the registration stream, the user terminal can open subsequent streams and it can end registrations. The user terminal can also open subsequent streams in which it can send packets which are used to perform “network login” to an Internet Service Provider (ISP).

During the registration stream, identities and capabilities are exchanged, operating 10 parameters are set, and a RID and PID are assigned. Later, a new network session may be created and attached to this RID, or an existing session may be handed over. This handover may be from another base station, another base station modem on the same base station (load shifting), or even from a hibernating session on the same base station modem. The specific details of registration are provided here as examples only. Many 15 other registration scenarios are also possible within the scope of the present invention.

Referring to Figure 8, the frame timing is established by the base stations that are in the area and transmitting on a pre-programmed RF carrier. The carrier may be a frequency hopping or spread spectrum carrier. However, it is preferred that the carrier be easy to find and be pre-programmed into the user terminals. The base stations, or base 20 station if there is only one, employ GPS or some other precise common timing reference to establish the frame timing 300. GPS timing offers the advantage that it is accurately synchronized and inexpensively available to all base stations. This allows the BCH to be shared by all the base stations with only a minimal guard time in the BCH between base stations. The base stations then build the BCH frame 302 described above and broadcast 25 in their respective assigned slots 304. When a user terminal turns on, it scans this well-

known, optionally pre-programmed, RF carrier 306 to find basic frame timing 308 and synchronization 310. The user terminal scans this carrier for BCH bursts, building an RSSI (Received Signal Strength Indicator) map 312. From this BCH RSSI map and other factors, the user terminal selects the strongest or the best base station 314. It also

5 uses the BCH to precisely adjust its oscillator frequency and adjust its frame timing reference 308, 310. This is done using the synchronization and timing sequences in the BCH burst, described above. Then, using its user or remote terminal ID (UTID) it builds

316 and sends 320 a Configuration Request CR, timed relative to the BCH burst for that strongest or best base station. In one embodiment, the CR is scrambled using the BS^CC

10 that was received in the BCH from the selected base station 318.

If the intended base station successfully receives the CR and has available capacity, it unscrambles the CR 322, and determines the spatial signature of the user terminal 324. The user terminal receives a Configuration Message burst CM in reply 326. The CM, described in greater detail below, contains sufficient information for the

15 user terminal to learn its distance and RF path-loss to the base station, correct its timing advance, adjust its power control, and learn the parameters of frequency hopping (e.g. frame numbering and BS^CC) 328. Several base stations may be probed with a CR to find the closest or the best base station. Based on this information from the CM, the user terminal, when it has data to transmit, can start a session, beginning with a random access

20 registration request RA-rreq 330. If resources are available, the base station sends an Access Assignment AA 332 to the user terminal assigning a traffic channel. The base station and user terminal exchange various access control parameters including encryption keys on this established stream. Finally a RID and PID are assigned. Using this RID, the user terminal can establish secure streams (e.g. RA-rts/AA-cts) in which it

25 transmits and receives internet packets 334.

The traffic channel includes a data acknowledgement DA or a data invalid DI response to each transmitted data packet. The DA and DI messages are transmitted as a part of the next data packet from the recipient in the next slot. In a time division duplex frame, the base station and the user terminal alternate slots 336, 338, 340, 342, as shown in Figure 8. Accordingly, if any slots are not received properly, the data can quickly be retransmitted. This reduces the size of the data buffers at the respective base station and user terminal modems. As shown in Tables 3 and 4, uplink slots always precede downlink slots and there is a guard time between the two in order to allow for any synchronization errors or unanticipated propagation delays. In one embodiment, each side transmits data packets in three slots, each slot including ramp-up and ramp-down periods as well as synchronization bits as is well-known in the art.

1	2	3		1	2	3		1	2	3	...
Uplink Slots	Guard Time	Downlink Slots	Guard Time		Uplink Slots						

Table 4

Periodically, the user terminal scans the BCH to update its RSSI and BSCC map. When it detects a better base station, it may send a CR to this new base station and possibly handover its network session. If successful stream initiation fails too many times, the user terminal enters a timeout state. From timeout, it may try to regain a RID via RA-req, refresh its timing advance using a CR, find a new base station to which it might handover by scanning the BCH, or even begin from scratch to re-acquire basic frame timing. If this re-establishment is successful, the user terminal may be able to continue its network session by completing a network session handover to the new base station.

Channel Considerations

In one embodiment, the network is designed to take maximal advantage of spatial division multiple access technologies and particularly smart antenna array signal processing. To help maintain reliable spatial channels in an extremely dense frequency reuse pattern, the network uses time division duplex TDMA where uplink and downlink transmissions are always on the same frequency. In addition, because many user terminals are single antenna and transmit and receive omnidirectionally, except for the 10 BCH, an uplink burst is always received before a downlink burst needs to be sent. This allows downlink bursts to be more accurately spatially directed. An uplink training sequence is embedded in every uplink burst to allow for moderately fast frequency hopping despite any decorrelation of the spatial channel with frequency.

The frequency hopping sequence may be any one of many different sequences 15 well-known in the art. The parameters of the frequency hopping scheme are initially unknown to the user terminal. This maximizes the flexibility of the network and increases the flexibility of the user terminal. As explained below, the frequency hopping parameters are transmitted to the user in the CM burst.

The robustness of the frequency hopping scheme and the traffic capabilities of the 20 system are improved if more frequency carriers can be allocated to the frequency hopping scheme. The BCH carrier is included as part of the frequency hopping scheme and, accordingly, used as a traffic channel. Since any one base station transmits a BCH burst only once per frame and since traffic is spatially directed to a particular user, a base station can transmit traffic channel data bursts during another base station's BCH burst 25 without significantly adding interference to user terminals that are listening for BCH

bursts on neighboring channels. Normally, the user terminal to which the traffic data burst is directed will not be listening for BCH bursts because it is already in a traffic session.

Because in the present embodiment there are 128 base stations each assigned to a different slot of the BCH, it is unlikely that the 128th portion of the BCH that is assigned to any one particular base station will overlap with a particular channel in the frequency hopping traffic channel scheme while that channel is being used for traffic. However, if it does, the base station broadcasts its BCH burst at its assigned time, listens for CR messages at its assigned time and transmits CM bursts in its assigned slot. This ensures further consistent operation of the network. For a user terminal, however, the use of the BCH carrier as a BCH will interrupt its traffic channel session. As a result, instead of receiving a data packet burst from the base station , it will receive the BCH burst. Even if the user terminal does not recognize this burst as BCH, it will immediately recognize it as having an invalid format for the expected data packet. Accordingly, in the next uplink frame, it will send a data invalid DI message with its burst and the base station will send the earlier expected data packet in the next available frame in the traffic channel. In the present timing scheme, the same slot in the next frame will coincide with a Configuration Message slot for that base station. The same slot in the next frame will coincide with a different base station's assigned BCH slot. However, even if the second slot also overlaps with the base station's BCH assignment, the same protocol can apply again. The remote terminal will again send a DI message and after the assigned BCH slot has passed, the base station will send the expected data burst. By relying on the acknowledgment protocol, the data capacity of the network can be increased to include most of the BCH without increasing the complexity of the signaling or processing resources.

The amount of data capacity increase will depend on how much of the RF resources are dedicated to the BCH and how many base stations are in the system. If there are a small number of base stations in the system, so that the BCH frame has a very short repeat, the network can be configured so that every BCH slot is used for BCH, 5 greatly reducing the amount of time for a remote user to acquire timing and synchronization and transmit a configuration request. Alternatively, the BCH can be configured so that only a small number of the possible 128 slots are used for BCH bursts and the rest of the channel capacity is left open for traffic. If there are a large number (i.e. close to 128) of base stations in the network, then it is unlikely that a user terminal 10 will be able to receive BCH bursts from more than ten percent of the possible base stations. As a result, the remaining ninety percent of the carrier can be used for data traffic without affecting new user terminals scanning for BCH bursts. The base station can be programmed with the BSID or BSCC of the nearby base stations so that it also will not transmit traffic during the BCH slots assigned to those base stations. The same 15 DI, retransmit scheme described above will compensate for any conflicts between neighboring BCH slots and the traffic channel.

Configuration Request CR

20 An example of a Configuration Request burst structure is shown in Figure 6. CR bursts are distinguished from random access RA and traffic TCH bursts, in part, by a special CR spatial training sequence. The CR training sequence is longer than normal and has periodic properties that make finding timing alignment especially computationally efficient. The CR burst is shorter than a standard uplink data burst to 25 allow for time-delay with unknown distance between the user terminal and base station.

The CR burst is shortened by 86 μ sec allowing an uncompensated time delay equivalent to a user terminal being about 15 km away from the base station.

The CR burst is transmitted from a user terminal at an unknown distance from the base station. Because of time-of-flight considerations, the user terminal time base is delayed relative to the base station. Furthermore, its CR transmission is also delayed because its timing advance is not yet initialized. Shortening the CR burst by 35 μ sec allows it to arrive up to 35 μ sec late without spilling over into the next time-slot. These 35 μ sec mean that a user terminal 5300 meters from the base station can send a CR burst that will land completely within its time-slot. If this burst is seen by the base station, and replied to, the corresponding CM will contain a timing advance adjustment which will properly position subsequent data bursts.

Table 5 below summarizes the content of the example CR burst as shown in Figure 6. The 82 information symbols are constructed from the configuration request message using modulation and coding.

Duration	Contents
10 μ sec	ramp-up
260 μ sec	training symbols a_1, a_2, \dots, a_{130}
164 μ sec	information symbols h_1, h_2, \dots, h_{82}
10 μ sec	ramp-down
86 μ sec	extra guard time
15 μ sec	inter-burst guard time

Table 5

- CR spatial training is the same for all base stations and the base station does not necessarily know the location of the user terminal before receiving the CR. CRs are transmitted by user terminals at a fixed offset from BCH transmissions as shown in Table 3. The resulting time-multiplexed registration channel easily distinguishes CRs sent to 5 different ones of several nearby base stations. Furthermore, CR and CM are scrambled by a function of BSCL ensuring that even if there is some interference from CRs sent to nearby base stations, the demodulation capture effect of the BSCL works out any collisions. In one embodiment, the scrambling is performed by taking the encoded bit sequence and exclusive OR'ing it with the output of a linear feedback shift register.
- 10 Finally the smart antenna spatial resolution ability of the base station is applied to resolve any remaining ambiguities in received CRs.

A configuration request message is mapped onto a configuration request burst CR by the physical layer. A configuration message is mapped onto a standard downlink burst by the physical layer. The information symbols of the present CR burst are mapped out as 15 shown in Table 6, below. Any of the items listed below can be deleted and transmitted later during the registration cycle or not at all based on the needs of the system.

Configuration Request Message	
Field	# of Bits
identity	8
utClass	4
txPwr	5
Total	17

Table 6

identity is a set of unique random bits for each user terminal that differentiate simultaneous messages from multiple user terminals. Because of the randomness and large number of bits, it is unlikely that two user terminals will select the same identity code at the same time.

5 utClass identifies user terminal capabilities (highest modulation class, frequency hopping capabilities, etc.) This sequence identifies the type of user terminal that sent the CR. A palmtop digital assistant might have different capabilities than a desktop computer with a fixed dedicated antenna. With utClass, the different capabilities can be distinguished.

10 txPwr represents the power used by the user terminal to transmit the Configuration Request burst. For example, user terminal power = $(2 \cdot \text{txPwr} - 30)$ dBm. CR is sent on the control carrier, as an example, exactly 2265 μ sec after receipt of a downlink BCH burst. In this way, an otherwise uninitialized user terminal can send CR without any knowledge of the frequency hopping sequence parameters. The CR burst is
15 shorter than a standard uplink time-slot to allow for unknown time-of-flight from the user terminal to the base station and typically arrives late in the uplink time-slot receive window.

Configuration Message CM

20 Table 7 below summarizes the content of an example Configuration Message burst as shown in Figure 7. The 494 information symbols are constructed from the configuration message using modulation and coding.

Duration	Contents
10 μ sec	ramp-up
68 μ sec	training symbols a_1, a_2, \dots, a_{130}
988 μ sec	information symbols h_1, h_2, \dots, h_{494}
10 μ sec	ramp-down
15 μ sec	inter-burst guard time

Table 7

The configuration message CM burst is sent on the BCH carrier, exactly 5 msec after sending a downlink BCH burst, whenever CR was received on the corresponding uplink

- 5 time-slot. Using this timing, CM is directed to the requesting user terminal. CM is also sent in a spatially directed signal based on the analysis of the spatial signature, for example parameters, such as DOA and TOA of the uplink CR. Since CM is sent on the BCH carrier, a fixed time offset from BCH, an otherwise uninitialized user terminal can receive CM without any knowledge of the frequency hopping sequence parameters. CM,
- 10 in response to CR, includes, among other things; the AFN (Absolute Frame Number), a larger timing-advance adjustment dynamic range, coarser power control, and various access control parameters. Table 8, below summarizes the content of the CM burst as shown in Figure 7. Any of the items listed below can be deleted and transmitted later during the registration cycle or not at all based on the needs of the system.

Configuration Message	
Field	# of Bits
identity	8
pwrCtrl	4
timingAdjust	7
AFN	10
carrierMask	16
racarrierMask	16
raslotMask	3
raDec	3
hopping	1
Total	70

Table 8

The meanings of the symbol sets are as follows:

identity: the random identity sent by the user terminal in the CR

pwrCtrl: power offset that the user terminal should apply to future parameter

5 request bursts and random access bursts: offset = $(2 \cdot \text{pwrCtrl} - 16)$ dB.

timingAdjust: timing advance that the user terminal should apply to future

random access bursts: timing advance = timingAdjust μs .

AFN: the 10 least significant bits of the Absolute Frame Number

carrierMask: bitmap of carriers containing traffic channels

10 racarrierMask: bitmap of carriers containing random access channels (least significant bit is carrier 0)

raslotMask: bitmap of slots containing random access channels (least significant bit is slot 1). Random access channels occur where both racarrierMask and raslotMask are nonzero.

raDec: AFNs available for random access channels.

- 5 hopping: if equal to 1, the relationship between physical and logical carriers hops each frame.

In the description above, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention.

It will be apparent, however, to one skilled in the art that the present invention may be

- 10 practiced without some of these specific details. In other instances, well-known structures and devices are shown in block diagram form.

The present invention includes various steps. The steps of the present invention may be performed by hardware components, such as those shown in Figures 1 to 4, or may be embodied in machine-executable instructions, which may be used to cause a
15 general-purpose or special-purpose processor or logic circuits programmed with the instructions to perform the steps. Alternatively, the steps may be performed by a combination of hardware and software.

The present invention may be provided as a computer program product which may include a machine-readable medium having stored thereon instructions which may

- 20 be used to program a computer (or other electronic devices) to perform a process according to the present invention. The machine-readable medium may include, but is not limited to, floppy diskettes, optical disks, CD-ROMs, and magneto-optical disks, ROMs, RAMs, EPROMs, EEPROMs, magnet or optical cards, flash memory, or other type of media / machine-readable medium suitable for storing electronic instructions.

- 25 Moreover, the present invention may also be downloaded as a computer program product,

wherein the program may be transferred from a remote computer to a requesting computer by way of data signals embodied in a carrier wave or other propagation medium via a communication link (e.g., a modem or network connection).

Importantly, while the present invention has been described in the context of a

- 5 wireless internet data system for portable handsets, it can be applied to a wide variety of different wireless systems in which data must be exchanged. Such systems include voice, video, music, broadcast and other types of data systems without external connections.
- The present invention can be applied to fixed remote terminals as well as to low and high mobility terminals. Many of the methods are described in their most basic form but steps
- 10 can be added to or deleted from any of the methods and information can be added or subtracted from any of the described messages without departing from the basic scope of the present invention. It will be apparent to those skilled in the art that many further modifications and adaptations can be made. The particular embodiments are not provided to limit the invention but to illustrate it. The scope of the present invention is
- 15 not to be determined by the specific examples provided above but only by the claims below.

CLAIMS:

1 1. A method comprising:
2 transmitting a broadcast burst in a broadcast channel from a base station of a radio
3 communications system;
4 receiving a request burst from a user terminal;
5 transmitting a message burst from the base station to the user terminal from which the
6 request burst was received, the message burst including a description of the channels
7 available on the radio communications system for receiving messages from user
8 terminals.

1 2. The method of Claim 1, wherein the description of the available channels
2 includes an identification of traffic channels of the radio communications system.

1 3. The method of Claim 1, wherein the description of the available channels
2 includes an identification of random access channels of the radio communications
3 system.

1 4. The method of Claim 1, wherein the message burst further includes an
2 indication of the transmit power level to be used by the user terminal in further
3 transmissions.

1 5. The method of Claim 4, wherein the request burst further includes an
2 indication of the power used by the user terminal to transmit the request burst and
3 wherein the indication of the transmit power to be used by the user terminal is based upon
4 the indication in the request.

1 6. The method of Claim 1, wherein the request includes an identification of
2 the user terminal.

1 7. The method of Claim 1, wherein the configuration message further
2 includes an indication of the timing adjustment to be used by the user terminal in further
3 transmissions.

1 8. The method of Claim 1, wherein the broadcast burst has a specific
2 transmission time and the request burst is received with a specific timing relationship to
3 the broadcast message, the method further comprising using the timing relationship to
4 determine a base station to which the request burst is directed.

1 9. The method of Claim 1, wherein the message burst is sent with a specific
2 timing relationship to the request burst, the method further comprising using the timing
3 relationship to direct the message burst to the user terminal from which the request burst
4 was received.

1 10. The method of Claim 1, wherein the broadcast burst further includes a
2 code to identify the transmitting base station and wherein receiving a request burst
3 comprises demultiplexing the request burst from the base station identifying code.

1 11. The method of Claim 10, wherein the code to identify the transmitting
2 base station comprises a base station color code.

1 12. The method of Claim 1, wherein the broadcast burst includes a power
2 sequence that is related to the power used to transmit the broadcast burst.

1 13. The method of Claim 1, wherein the broadcast burst includes a load
2 sequence that is related to the current traffic load at the base station.

1 14. The method of Claim 1, further comprising analyzing the spatial direction
2 from which the request burst is received and wherein transmitting the message burst
3 comprises transmitting the message burst spatially directed toward the user terminal
4 based on the spatial direction analysis.

1 15. The method of Claim 14, wherein analyzing the spatial direction
2 comprises determining direction of arrival parameters from the received message burst.

1 16. A machine-readable medium having stored thereon data representing
2 sequences of instructions which, when executed by a machine, cause the machine to
3 perform operations comprising:
4 transmitting a broadcast burst in a broadcast channel from a base station of a radio
5 communications system;
6 receiving a request burst from a user terminal;
7 transmitting a message burst from the base station to the user terminal from which the
8 request burst was received, the message burst including a description of the channels
9 available on the radio communications system for receiving messages from user
10 terminals.

1 17. The medium of Claim 16, wherein the description of the available
2 channels includes an identification of traffic channels of the radio communications
3 system.

1 18. The medium of Claim 16, wherein the description of the available
2 channels includes an identification of random access channels of the radio
3 communications system.

1 19. The medium of Claim 16, wherein the message burst further includes an
2 indication of the transmit power level to be used by the user terminal in further
3 transmissions.

1 20. The medium of Claim 19, wherein the request burst further includes an
2 indication of the power used by the user terminal to transmit the request burst and
3 wherein the indication of the transmit power to be used by the user terminal is based upon
4 the indication in the request.

1 21. The medium of Claim 16, wherein the broadcast burst has a specific
2 transmission time and the request burst is received with a specific timing relationship to
3 the broadcast message, the instructions further causing the machine to perform operations
4 comprising using the timing relationship to determine a base station to which the request
5 burst is directed.

1 22. The medium of Claim 16, wherein the message burst is sent with a
2 specific timing relationship to the request burst, the instructions further causing the
3 machine to perform operations comprising using the timing relationship to direct the
4 message burst to the user terminal from which the request burst was received.

1 23. The medium of Claim 16, wherein the broadcast burst includes a load
2 sequence that is related to the current traffic load at the base station.

1 24. The medium of Claim 16, the instructions further causing the machine to
2 perform operations comprising analyzing the spatial direction from which the request
3 burst is received and wherein the instructions for transmitting the message burst further
4 comprise instructions causing the machine to perform operations comprising transmitting
5 the message burst spatially directed toward the user terminal based on the spatial
6 direction analysis.

1 25. An apparatus comprising:
2 a transmitter of a base station of a radio communications system to transmit a
3 broadcast burst in a broadcast channel;
4 a receiver of the base station to receive a request burst from a user terminal;
5 a processor of the base station to assemble a message burst for transmission to the
6 user terminal from which the request burst was received, the message burst including a
7 description of the channels available on the radio communications system for receiving
8 messages from user terminals.

1 26. The apparatus of Claim 25, wherein the description of the available
2 channels includes an identification of traffic channels of the radio communications
3 system.

1 27. The apparatus of Claim 25, wherein the description of the available
2 channels includes an identification of random access channels of the radio
3 communications system.

1 28. The apparatus of Claim 25, wherein the request burst further includes an
2 indication of the power used by the user terminal to transmit the request burst and

3 wherein the message burst includes an indication of the transmit power to be used by
4 the user terminal based upon the indication in the request.

1 29. The apparatus of Claim 25, wherein the broadcast burst has a specific
2 transmission time and the request burst is received with a specific timing relationship to
3 the broadcast message, and wherein the processor uses the timing relationship to
4 determine a base station to which the request burst is directed.

1 30. The apparatus of Claim 25, wherein the message burst is sent with a
2 specific timing relationship to the request burst, to direct the message burst to the user
3 terminal from which the request burst was received.

1 31. The apparatus of Claim 25, wherein the broadcast burst includes a load
2 sequence that is related to the current traffic load at the base station.

1 32. The apparatus of Claim 25, further comprising a spatial processor to
2 analyze the spatial direction from which the request burst is received and to transmit the
3 message burst spatially directed toward the user terminal based on the spatial direction
4 analysis.

1 33. An apparatus comprising:
2 means for transmitting a broadcast burst in a broadcast channel from a base station of
3 a radio communications system;
4 means for receiving a request burst from a user terminal;
5 means for transmitting a message burst from the base station to the user terminal from
6 which the request burst was received, the message burst including a description of the

7 channels available on the radio communications system for receiving messages from user
8 terminals.

1 34. The apparatus of Claim 33, wherein the description of the available
2 channels includes an identification of traffic channels of the radio communications
3 system.

1 35. The apparatus of Claim 33, wherein the description of the available
2 channels includes an identification of random access channels of the radio
3 communications system.

1 36. The apparatus of Claim 33, wherein the message burst further includes an
2 indication of the transmit power level to be used by the user terminal in further
3 transmissions.

1 37. The apparatus of Claim 33, wherein the message burst further includes an
2 indication of the timing adjustment to be used by the user terminal in further
3 transmissions.

1 38. The apparatus of Claim 33, wherein the broadcast burst has a specific
2 transmission time and the request burst is received with a specific timing relationship to
3 the broadcast message, the apparatus further comprising means for using the timing
4 relationship to determine a base station to which the request burst is directed.

1 39. The apparatus of Claim 33, wherein the message burst is sent with a
2 specific timing relationship to the request burst, the apparatus further comprising means
3 for using the timing relationship to direct the message burst to the user terminal from
4 which the request burst was received.

1 40. The apparatus of Claim 33, wherein the broadcast burst includes a load
2 sequence that is related to the current traffic load at the base station.

1 41. A method for requesting access on a wireless network comprising:
2 receiving a plurality of timing sequences on a broadcast channel from at least one
3 base station;
4 determining network timing using the received timing sequences;
5 using the network timing to determine a network access request transmission time;
6 transmitting a network access request at the determined time; and
7 receiving a message burst from a base station, the message burst including a
8 description of the channels available on the wireless network.

1 42. The method of Claim 16, wherein the description of the available channels
2 includes an identification of traffic channels of the radio communications system.

1 43. The method of Claim 16, wherein the description of the available channels
2 includes an identification of random access channels of the radio communications
3 system.

1 44. The method of Claim 16, wherein the message burst further includes an
2 indication of the transmit power level to be used by the user terminal in further
3 transmissions.

1 45. The method of Claim 16, wherein the message burst further includes an
2 indication of the timing adjustment to be used by the user terminal in further
3 transmissions.

1 46. The method of Claim 16, wherein the timing sequences include a power
2 sequence that is related to the power used to transmit the timing sequence.

1 47. The method of Claim 21, wherein transmitting a request further comprises
2 transmitting a request with a power selected based on the received power sequence.

1 48. The method of Claim 16, wherein the timing sequences include a load
2 sequence that is related to the current traffic load at the base station.

1 49. The method of Claim 16, wherein the timing sequences are received from
2 a plurality of different base stations and wherein the method further comprises
3 distinguishing different base stations using the time at which different timing sequences
4 are received.

1 50. The method of Claim 16, wherein transmitting a request comprises
2 transmitting a request to a selected one of the plurality of different base stations by
3 transmitting the request at a time having a specific relationship to the time at which a
4 timing sequence is received from the selected base station.

1 51. The method of Claim 16, wherein the timing sequences are received with
2 at least one frequency and wherein the method further comprises using the received
3 timing sequences to determine a request transmission frequency based on the frequency
4 of the received timing sequences.

1 52. The method of Claim 16, further comprising receiving a base station
2 identifier on the broadcast channel and using the base station identifier to distinguish
3 broadcasts from different base stations on the same broadcast channel.

1 53. The method of Claim 16, wherein receiving a timing sequence further
2 comprises receiving an identification of the base station and wherein transmitting a
3 request further comprises transmitting the base station identification.

1 54. The method of Claim 28, wherein the code to identify the transmitting
2 base station comprises a base station color code.

1 55. The method of Claim 29, wherein transmitting a request comprises
2 multiplexing the request with the base station identifying code.

1 56. The method of Claim 16, wherein transmitting a request further comprises
2 transmitting an identifier of the transmitter.

1 57. A machine-readable medium having stored thereon data representing
2 sequences of instructions which, when executed by a machine, cause the machine to
3 perform operations comprising:
4 receiving a plurality of timing sequences on a broadcast channel of a wireless
5 network from at least one base station;
6 determining network timing using the received timing sequences;
7 using the network timing to determine a network access request transmission time;
8 transmitting a network access request at the determined time; and
9 receiving a message burst from a base station, the message burst including a
10 description of the channels available on the wireless network.

1 58. The medium of Claim 57, wherein the description of the available
2 channels includes an identification of traffic channels of the radio communications
3 system.

1 59. The medium of Claim 57, wherein the description of the available
2 channels includes an identification of random access channels of the radio
3 communications system.

1 60. The medium of Claim 57, wherein the message burst further includes an
2 indication of the transmit power level to be used by the user terminal in further
3 transmissions.

1 61. The medium of Claim 57, the instructions for transmitting a request
2 comprise further instructions causing the machine to perform operations comprising
3 transmitting a request with a power selected based on the received power sequence.

1 62. The medium of Claim 57, wherein the instructions for transmitting a
2 request comprise further instructions causing the machine to perform operations
3 comprising transmitting a request to a selected one of the plurality of different base
4 stations by transmitting the request at a time having a specific relationship to the time at
5 which a timing sequence is received from the selected base station.

1 63. The medium of Claim 57, wherein the instructions for transmitting a
2 request comprise further instructions causing the machine to perform operations
3 comprising multiplexing the request with a base station identifying code.

1 64. An apparatus for requesting access on a wireless network comprising:
2 means for receiving a plurality of timing sequences on a broadcast channel from at
3 least one base station;
4 means for determining network timing using the received timing sequences;
5 means for using the network timing to determine a network access request

6 transmission time;
7 means for transmitting a network access request at the determined time; and
8 means for receiving a message burst from a base station, the message burst including
9 a description of the channels available on the wireless network.

1 65. The apparatus of Claim 64, wherein the description of the available
2 channels includes an identification of traffic channels of the radio communications
3 system.

1 66. The apparatus of Claim 64, wherein the description of the available
2 channels includes an identification of random access channels of the radio
3 communications system.

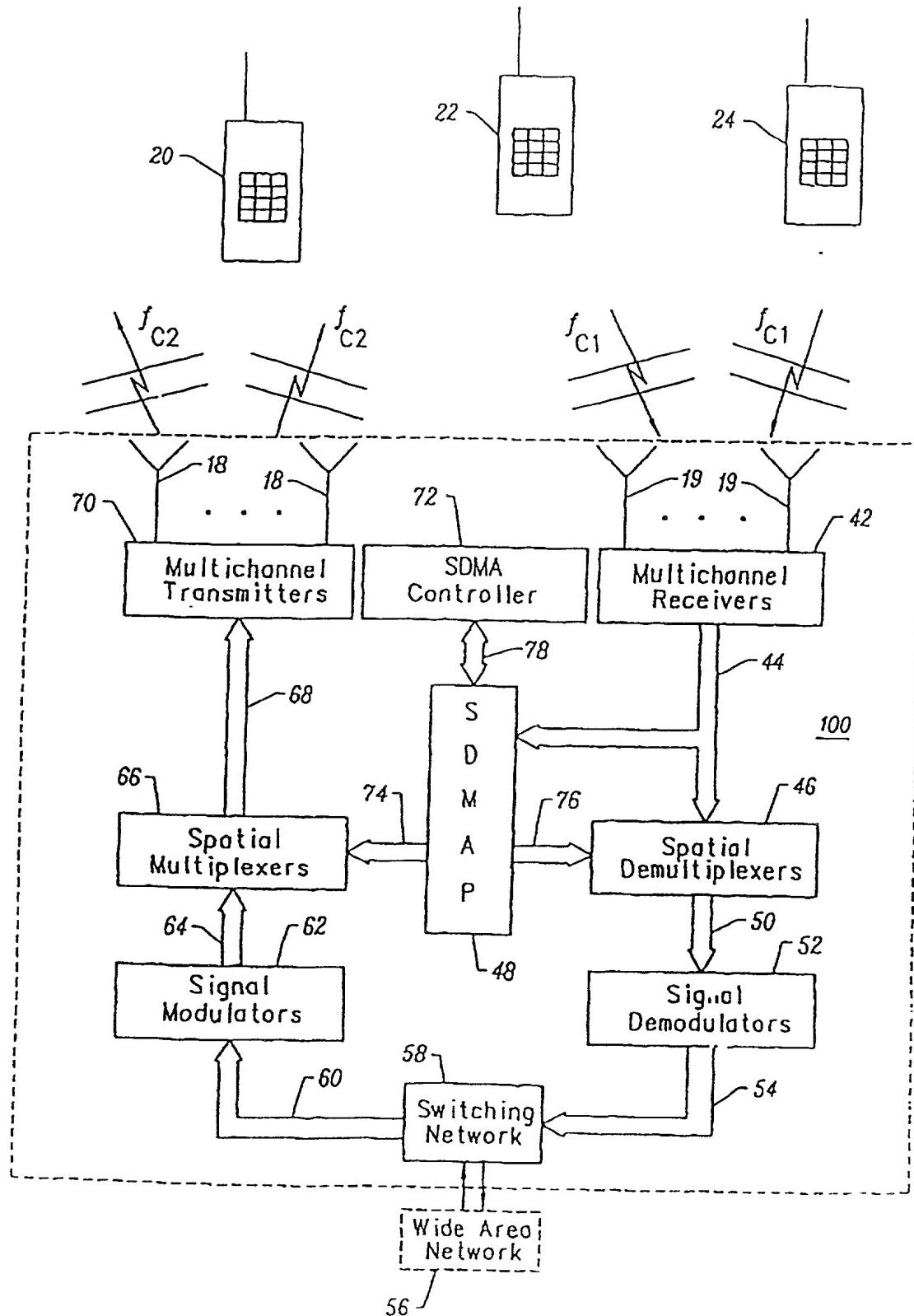
1 67. The apparatus of Claim 64, wherein the message burst further includes an
2 indication of the transmit power level to be used by the user terminal in further
3 transmissions.

1 68. The apparatus of Claim 64, wherein the means for transmitting a request
2 comprises means for transmitting a request to a selected one of the plurality of different
3 base stations by transmitting the request at a time having a specific relationship to the
4 time at which a timing sequence is received from the selected base station.

ABSTRACT OF THE DISCLOSURE

In one embodiment, the present invention comprises transmitting a broadcast burst in a broadcast channel from a base station of a radio communications system. The invention further comprises receiving a request burst from a user terminal, and transmitting a message burst from the base station to the user terminal from which the request was received. The message burst includes a description of the channels available on the radio communications system for receiving messages from user terminals.

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VERSION FOR GOVERNMENT
USE



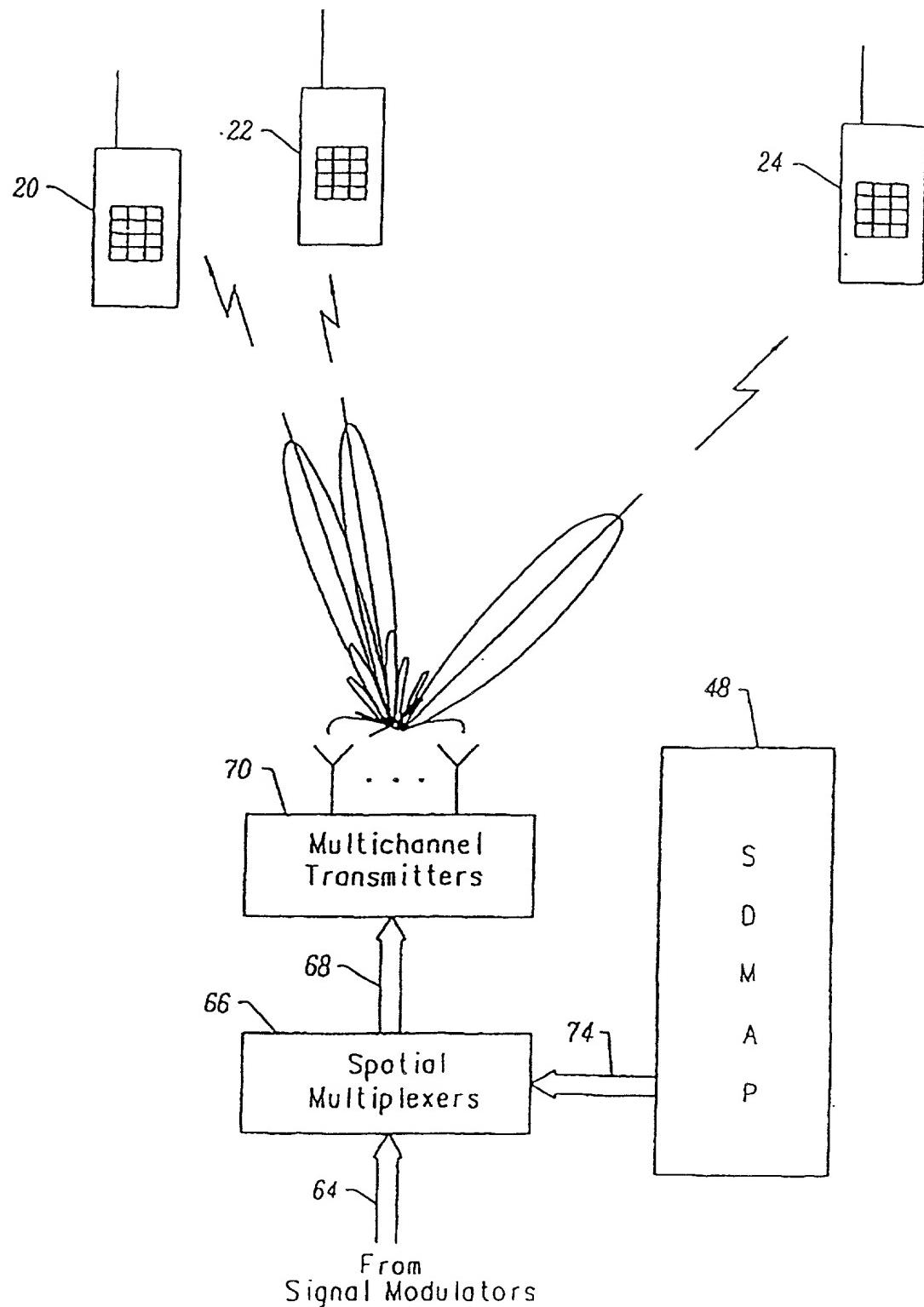


FIG. 2

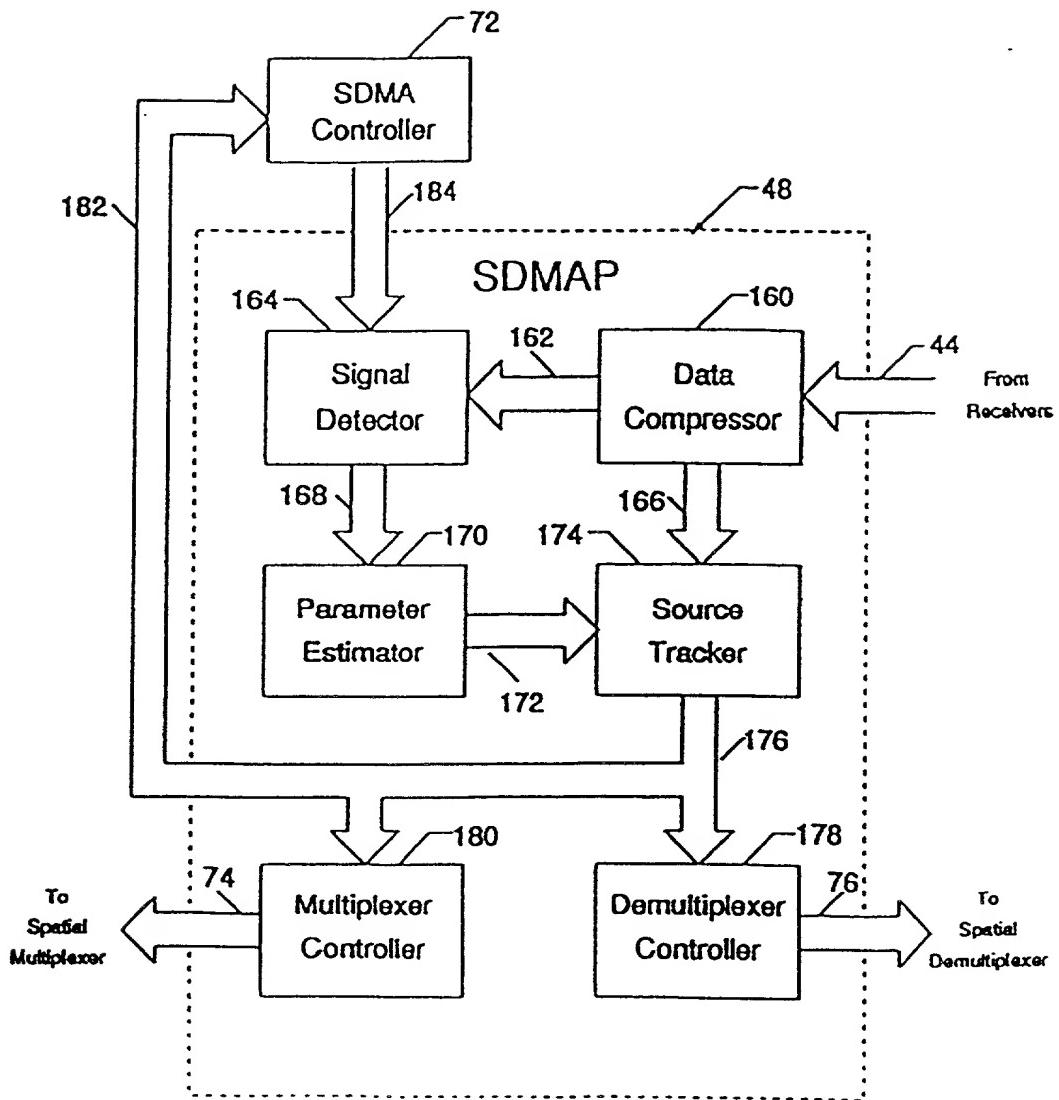


FIG. 3

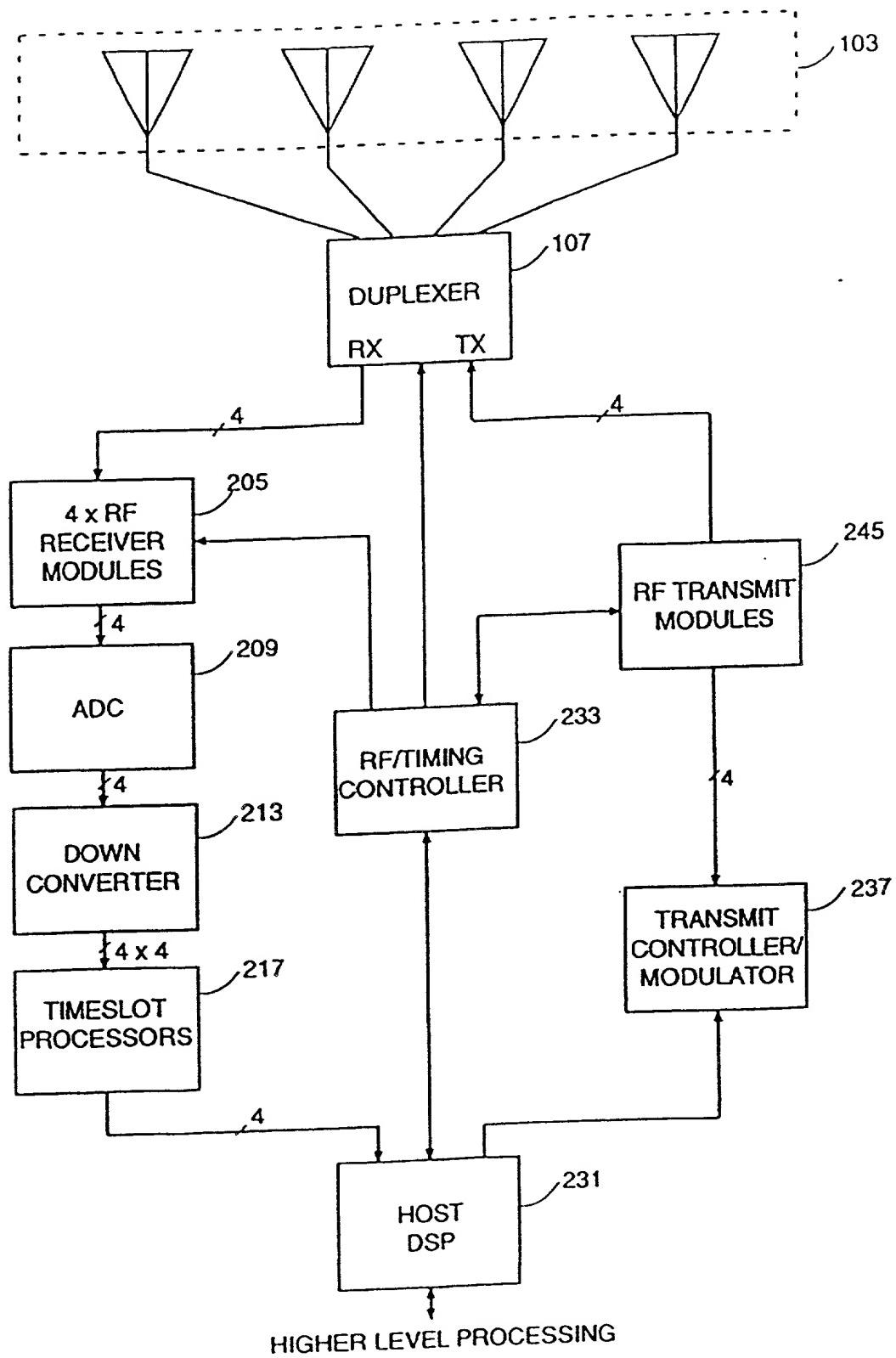


Figure 4

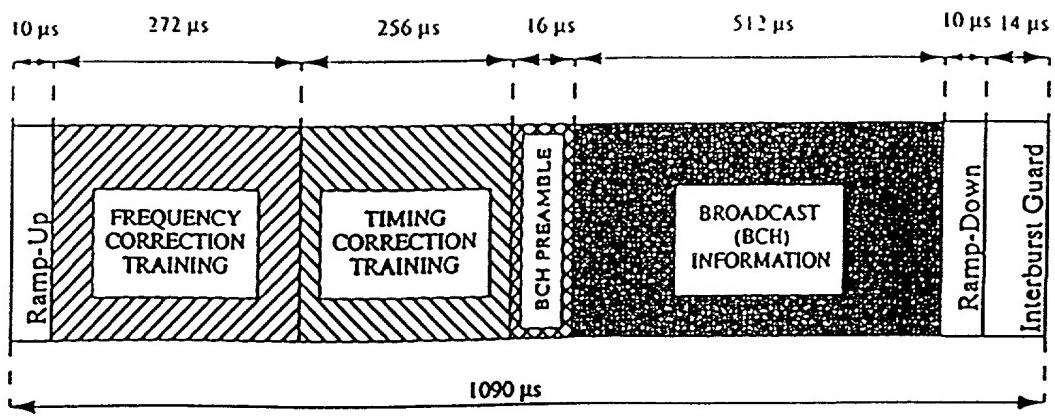


FIG. 5

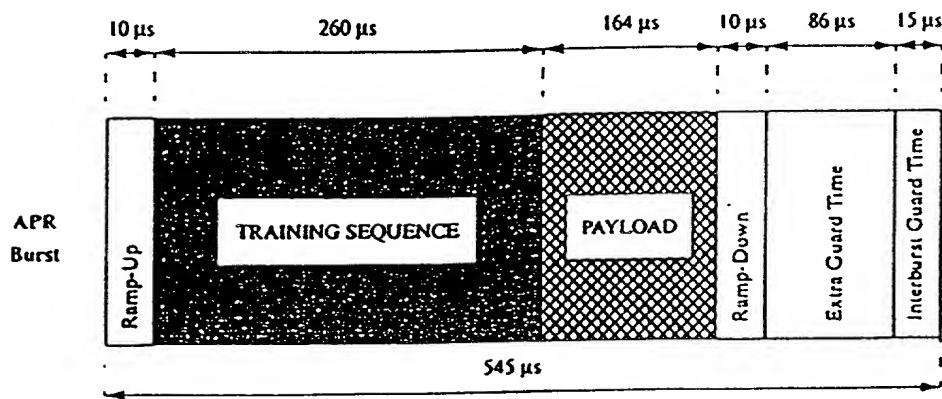


FIG. 6

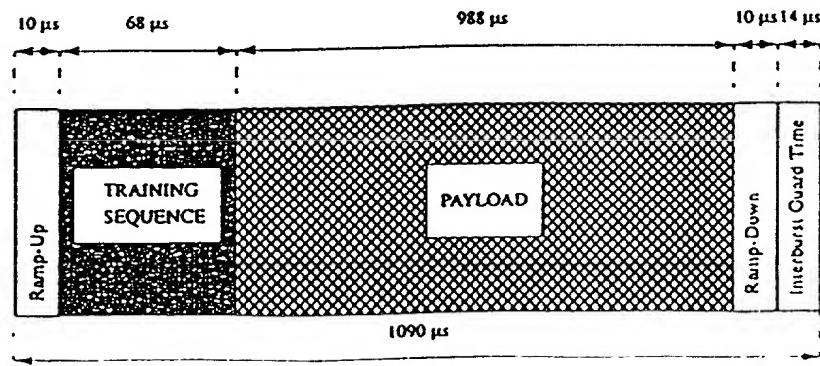


FIG. 7

	Base Station		Remote Terminal
300	Acquire GPS Timing		
302	Determine BCH slot time		
304		BCH \Rightarrow	
306			Scan BCH channels
308			Acquire Frame Timing
310			Acquire Synchronization
312			Build Map of Base Stations BCHs and BSCCs
314			Select Base Station
316			Build CR using UTID and transmit power
318			Scramble CR using BSCC
320		\Leftarrow Configuration Request	
322	Unscramble CR using BSCC		
324	Determine Spatial Signature of Remote CR		
326		Configuration Message \Rightarrow	
328			Adjust timing and power
330		\Leftarrow Traffic Request	
332		Traffic Assignment \Rightarrow	
334		\Leftarrow Traffic \Rightarrow	
336		Send packet \Rightarrow	
338		\Leftarrow Send DA and packet	
340		Send DA and packet \Rightarrow	
342		\Leftarrow Send DA and packet	

Figure 8

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Radio Communications System with a Minimal Broadcast Channel

the specification of which

X is attached hereto.
— was filed on _____ as
United States Application Number _____
or PCT International Application Number _____
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority
Claimed

(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Gordon R. Lindeen III, BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct telephone calls to (303) 740-1980.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56 Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.